SENSORY EXTINCTION: ITS EFFECTS ON TARGET STEREOTYPED BEHAVIORS IN ADJACENT NON-PROGRAMMED SITUATIONS

An abstract of a Thesis by
Duane J. Dolphin
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Drake University
Advisor: Larry A. Alferink

The problem. Recent studies have demonstrated that sensory extinction procedures can be effective in decreasing behavioral stereotypies. When a sensory extinction procedure is not continually maintained, the potential exists for an alternation between schedules of reinforcement and extinction. Studies from the animal literature indicate that this alternation can give rise to schedule interactions and result in possible unwanted effects on the target stereotypy. This study will assess possible additional effects of sensory extinction procedures on behavioral stereotypies in adjacent non-extinction settings.

Procedure. Sensory extinction procedures were developed for two subjects. The procedures were then introduced and withdrawn in strict alternating fashion. The frequency and cumulative time spent responding was assessed during extinction as well as non-extinction periods.

Findings. For both subjects, stereotyped responding in periods when the extinction procedure was introduced decreased below baseline levels. In the non-extinction periods for one subject, responding increased over baseline levels. During a second phase, response levels for both subjects again decreased below baseline levels during extinction periods. Response measures also decreased for both subjects below baseline levels in periods when the extinction procedure was withdrawn.

Conclusion. The sensory extinction procedures used in the study were effective in decreasing stereotyped responding. These procedures also had an effect on the stereotypies in the non-extinction settings, as these responses deviated from baseline.

Recommendations. The study indicates that sensory extinction procedures can lead to unintended effects on responding in adjacent non-programmed settings. Clinicians using such procedures need to assess what the exact effects, if any, will be. Further research needs to assess whether these findings extend to more clinically relevant situations.

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Duane J. Dolphin

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by

Duane J. Dolphin

Approved by Committee:

Larry A. Alford
Chairperson

Phillip K Duncan

Donald B. Stratton

Dean of the School of Graduate Studies

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CHAPTER I

INTRODUCTION

Recent studies (Rincover, 1978; Rincover, Cook, Peoples, & Packard, 1979) have demonstrated that the auditory, visual or proprioceptive sensory consequences of responding control the occurrence and maintenance of a class of stereotyped behaviors labeled "self-stimulation" (Lovaas, 1967). These sensory events have also been used as consequents in the shaping of leverpressing in retardates (Meyerson, Kerr, & Michael, 1967; Bailey & Meyerson, 1969; Rincover, Newsom, Lovaas, & Koegel, 1977), pilltaking (Schaefer, 1960), and appropriate toy-play (Rincover et al., 1979). In conjunction with experiments from the animal literature (Kish, 1966; Marx, Henderson, & Roberts, 1955), these studies provide the basis for the concept of sensory reinforcement (Kish, 1955; Fowler, 1971; Rincover et al., 1979). From this vantage, behavioral stereotypies are viewed as operants under the control of their specific sensory consequence. These stereotypies also exhibit another functional property of operants in that if the sensory consequence can be eliminated or masked, stereotyped responding undergoes extinction. Rincover (1978) has introduced a new procedure, sensory extinction, to examine this functional relation and has since found the procedure to be an alternate treatment strategy for the control of stereotyped

behavior. It has attracted attention due to the generally inconsistent results of other treatments such as differential reinforcement of other behavior (DRO), timeout and overcorrection (Greene, Hoats, & Hornick, 1970; Foxx & Azrin, 1973; Sachs, 1973).

Since the procedure has been shown to result in immediate decreases in response rates, is relatively easy to implement with minimal staff training and is free from serious ethical considerations (Rincover et al., 1979), sensory extinction appears to be an attractive alternative treatment strategy in the control of stereotyped responding.

Due to the recency of the procedure's use in the deceleration of stereotyped responding, its effectiveness in comparison to more widely used procedures has yet to be assessed (Foxx & Azrin, 1973; Harris & Wolchik, 1979). The present direction research in this area has taken is toward examining the multiple effects on behavior as a result of sensory reinforcement and sensory extinction principles (Rincover et al., 1979). Specifically, if the sensory consequences maintaining behavior were identified and toys made available which produced the preferred sensory consequence, appropriate toy play was shaped and maintained by these events without external reinforcers programmed. These treatment gains were found to be relatively lasting over time.

Another additional effect of an intervention on the

target response that is of interest to researchers and of value to clinicians is the degree to which the response is affected in other settings where the intervention is not programmed. The specific operation that defines sensory extinction is the withdrawal of the reinforcer maintaining the target response. The schedule is changed from one of reinforcement to a schedule of extinction. The effect on responding in the extinction schedule is a decrease in response frequency (Rincover, 1978). When the schedule of reinforcement is again made available, by means of withdrawal of the extinction procedure, the response increases, approximating pre-extinction levels. In any given clinical setting, the use of a sensory extinction procedure to decelerate behavior will be ideal if the sensory event maintaining the stereotypy is eliminated or masked at all times. When this ideal state cannot be achieved, the effect of sensory extinction would be an alternation between schedules of reinforcement when the sensory event is not masked or eliminated and schedules of extinction when the procedure is implemented. Research in the experimental analysis of behavior suggests that if schedules of reinforcement alternate with schedules of extinction, the decrease in response rate in the extinction schedule will be accompanied by an increase in the rate of behavior in the reinforcement schedule over baseline levels, even though that schedule has not been altered (Reynolds, 1961). This

phenomenon is known as positive behavioral contrast and the increase in responding is attributed to an interaction between the two schedules (Schwartz & Gamzu, 1977).

The possible implication of this interaction in relation to the sensory extinction procedure is that the frequency of stereotyped responding may increase over baseline levels in an adjacent setting where no extinction procedure is programmed when the stereotypies are decreased in frequency due to a sensory extinction procedure programmed in a prior setting. This increase in responding above baseline levels may be viewed as an unwanted side effect of the sensory extinction procedure, but it would in fact be an additional behavioral effect of the way in which the procedure was implemented.

Positive behavioral contrast is not the only type of interaction that could occur due to the alternating schedules. Negative induction could also be found due to the interaction of the schedules. This would be defined as a decrease in response frequency compared to baseline levels in a non-extinction setting as the frequency of responding decreases in the extinction setting. A third possibility is that response measures will not appreciably change in the non-extinction setting as response measures decrease in the extinction setting.

The potential exists for an alternation between schedules of reinforcement and extinction in cases where

the sensory event maintaining the target response may not be effectively masked or eliminated. With potential schedule interaction occurring that may result in undesirable increases in the target response due to such procedures, the purpose of this study is twofold. The first focus will be the use of sensory extinction procedures to decrease behavioral stereotypies and extend the findings concerning the usefulness of the procedures. The second focus will be on assessing any possible effects on the target response in an adjacent setting where the extinction procedure is not programmed. The intent here is on assessing potential additional effects on behavior and the variables that give rise to these effects.

CHAPTER II

METHOD

Subjects

Two mentally handicapped individuals exhibiting stereotyped behaviors participated in this study. Both were male. They were selected out of a number of referrals made by teachers, primarily on the basis of the presence of a high rate of behavioral stereotypy. This was further assessed through individual observation.

Subject one. The response under study consisted of the subject striking the left temple area with objects available to him. The objects the subject would select had the common property of a relative hardness and rigidity in comparison to more soft, pliable objects that were ignored. The response specifically consisted of bursts of one or more strikes directed at the temple area and caused no apparent injury or pain, although a large callous could be observed in the area. Since it was difficult for an observer to record singular strikes to the temple because of high rates, bursts of one or more strikes to the temple were the behavioral unit under study. A burst of strikes will be referred to as an episode.

Subject two. The response under study consisted of stereotyped headweaving and was defined as a horizontal turning of the head from side to side in an alternating

manner. The behavioral unit under study was episodes of headweaving consisting of one or more 180 degree sweeps of the subject's face from side to side.

Setting

For the first subject, the initial phase of the study was conducted in a 10 foot by 10 foot partitioned activity area within a larger room in the school he attended. During this phase for the second subject, the study was also conducted in a 10 foot by 15 foot activity room in the school he attended. All sessions for both subjects were conducted in the morning, five days a week. In each of the experimental rooms, one table and one chair was placed for the subject. Additional chairs facing the subjects were provided for the data recorders.

Procedure

Each subject was observed for three days and teachers were consulted in an attempt to identify possible sensory events maintaining the specific response for each subject. Based on this information, a procedure was developed that would mask or eliminate the sensory consequence hypothesized to control each stereotypy. These operations will be referred to as the sensory extinction procedures.

Sensory extinction procedure for subject one. The sensory event suspected of maintaining this subject's

striking of his temple area was the relative hardness of the objects selected. The object made available to the subject for engaging in the stereotyped response was a plastic, hollow toy bowling pin, approximately seven inches in length. This object was most frequently chosen by him from the usual toys available to him in his free time at the school. In an attempt to eliminate the hardness of the object, a pin of similar dimensions and color was constructed of foam rubber. The sensory extinction procedure consisted of presenting the subject with this foam pin while withdrawing the plastic pin.

Sensory extinction procedure for subject two. In a replication of a procedure used by Rincover (1978) to decrease stereotyped handflapping by applying a vibrator to the hand, a vibrator will be placed on the back of the subject's neck by means of fastening it to the subject's shirt collar so that the vibrator contacts the skin. The attempt will be to decrease episodes of headweaving. According to Rincover, the purpose of the vibrator is to mask the proprioceptive stimuli maintaining the stereotyped response. This would follow his definition of a sensory extinction procedure.

Recording the responses. Each twenty minute session was divided into four blocks or components of five minutes. During each of the four components, the dependent variable under direct observation was the target stereotypy for each

subject. The number of episodes and the duration of each episode was recorded. These continuous measures were provided by means of a portable one-channel, encoder-decoder (Magyar & Fitzsimmons, 1979). Whenever the subject engaged in the stereotyped response, a pushbutton activating the device was depressed and held down until the response terminated (no observation of the response for at least two seconds). The behavioral record encoded on standard cassette tape was played back through electro-mechanical relay equipment programmed to activate an event recorder. A historical record of the response measures was then obtained and the number of episodes and cumulative duration of responding was calculated for each five minute component. Both subjects were exposed to the same sequence of conditions.

Baseline. No sensory extinction procedure was implemented. In the experimental rooms, Subject One was presented with the plastic pin, Subject Two was given one verbal prompt to place various shaped blocks into a shape cube present at the table. The target stereotypy was then observed in each case and recorded across all components. Response measures from components one and three were summed, then compared to measures in components two and four.

Experimental. During this condition, the sensory extinction procedure was introduced for each subject during

components one and three, then withdrawn during components two and four. Again, the response measures were summed in components one and three and compared to measures in components two and four.

Return to Baseline. No sensory extinction procedure was implemented. Previous baseline conditions were reinstated to assess the effect on the response measures.

Based on the data obtained in the first phase of the study, a systematic replication of the previous procedures was carried out approximately four months after the first phase was completed. The purpose of this replication was to enhance the positive behavioral contrast found with the first subject and to enhance any schedule interaction occurring with the second subject, in the case that the variability of the stereotyped response obscured the presence of an interaction. In this second phase, the experimental manipulations for the first subject took place in the home setting. An 8 by 20 foot activity room in the basement of the home was cleared for use as the experimental space. These sessions were conducted in the evenings, five nights a week. For the second subject, the manipulations were again conducted at the school but in a different area. This area consisted of a 5 by 5 foot partitioned enclosure within a larger, unused activity room. Sessions were conducted at the same approximate morning hours, five days a week. Both rooms were equipped in the same manner as

described in the first phase.

In this second phase, the component duration of five minutes used in the previous phase was switched to a component duration of one minute. This resulted in a session of twenty, one-minute components instead of a session of four, five-minute components. Both subjects were again exposed to the same sequence of conditions.

Baseline. Previous baseline conditions were replicated within the new settings. The number of episodes and the duration measures of the target responses were summed across all odd-numbered components, then compared to response measures in all even-numbered components.

Experimental. The sensory extinction procedures used in the previous manipulations were again introduced to the respective subjects in the first one-minute component and withdrawn in the second one-minute component. The procedure continued to be introduced and withdrawn in strict alternating order. Sensory extinction procedures occurred in all odd-numbered components and were withdrawn in all even-numbered components.

Return to Baseline. Conditions from the previous baseline procedures were reinstated to assess effects on the target response measures.

After return to baseline for the second subject, he was exposed to a condition in which the sensory extinction procedure was again introduced and withdrawn in a strict

alternating manner. The only exception in this condition was that the vibrator was not turned on. After this procedure, conditions were again returned to baseline procedures.

Agreement. A second observer was used to assess interobserver agreement of the number and duration measures, at least once in each condition for each subject. In many instances there were at least two agreement assessments per condition. The second observer also used a one-channel, encoder-decoder similar to that used by the primary observer. The second observer was previously trained in observing and recording the response measures for each subject. This was done through a review of response definitions and practice with each subject prior to the start of the study. An agreement of 80% or higher on both measures for two consecutive practice sessions was used as criteria for observer proficiency to begin the study. Response definitions were reviewed prior to each session.

The agreement assessment of cumulative duration of time engaged in stereotyped responding was calculated by dividing the smaller cumulative duration time by the larger time and multiplying by 100, to obtain the percent agreement.

An agreement on the occurrence of an episode of stereotyped responding was counted when one observer recorded the onset of an episode within three seconds of the

onset of an episode recorded by the other observer. Agreement of the number of episodes was calculated by dividing the total number of agreements by the sum of the agreements plus disagreements and multiplying by 100, to obtain the percent agreement.

CHAPTER III

RESULTS

Agreement

Subject one. The percentage agreement for occurrence of episodes ranged from 89% to 93%, with a mean of 92%. The cumulative duration agreement ranged from 80% to 100%, with a mean of 97%.

Subject two. The percentage agreement for occurrence of episodes ranged from 84% to 95%, with a mean of 90%. The cumulative duration agreement ranged from 95% to 100%, with a mean of 98%.

Measures of Behavioral Stereotypies

Subject one. Figure 1 shows the number of episodes and cumulative duration of responding across the five minute components for the first subject, whose response consisted of headstrikes. During Baseline, the number of episodes and cumulative duration measures summed across components one and three were approximately equivalent to the response measures in components two and four. It should be noted that the subject became extremely ill for approximately one month during the Baseline condition. The decrease in episodes on day eight is correlated with the subject's return from his illness. Episodes remained relatively low for the remainder of Baseline. The duration spent in responding in

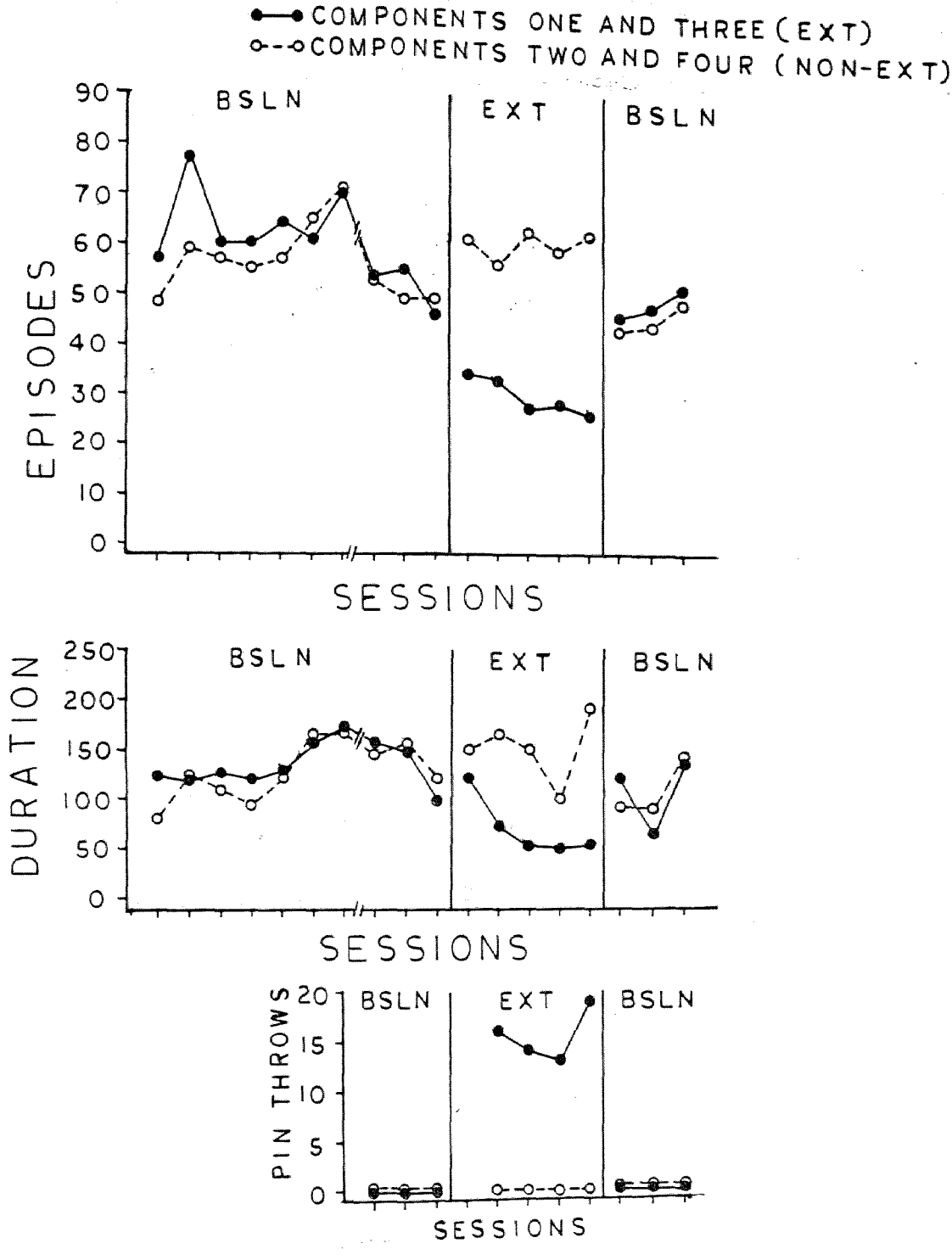

Figure 1 Episodes and cumulative duration of stereotyped headstriking (subject one) in extinction versus non-extinction components as a function of the sensory extinction procedure with component length of five minutes. Collateral data of pin throwing also presented.

the last half of the condition increased compared to earlier sessions. The response measure of duration did not show a decrease, as was found in episodes, when the subject returned after his illness.

During the Experimental condition, a decreasing trend was observed in both response measures in components where the sensory extinction procedure was implemented. The number of episodes showed a mean of 29.6, ranging from 34 the first session to 26 in the final session. This compares to a mean of 51.6 episodes in the last three Baseline sessions. Cumulative time spent in responding also decreased from 121 seconds in the first session to 54 seconds in the final session. The mean cumulative duration was 70 seconds, compared to 134 seconds in the final three Baseline sessions.

In components two and four where the extinction procedure was withdrawn, an increase was observed in the number of episodes. They ranged from 61 the first session to 62 in the last session, with a mean number per session of 60 episodes. This compares with a mean of 50.6 episodes during the final three Baseline sessions. Cumulative duration did not indicate such a clear increase in components two and four. Responding ranged from 150 seconds in the first to 192 seconds in the final session with a mean per session of 152 seconds. This is slightly higher than the mean of 141 seconds in the final three Baseline sessions.

In the Return to Baseline condition, both measures returned to the levels found in the Baseline condition when using the last three sessions as reference data.

Collateral data of interest are also found in Figure 1. During the study, the subject was observed to throw the pin used in the sensory extinction procedure. In the Baseline condition, pin throwing was not observed during the four components. In the Experimental condition, pin throws increased to a mean of 15 per session but only occurred during components two and four with the plastic pin. In Return to Baseline, no instance of pin throwing was observed in any component. The foam pin was never presented or present in this condition.

The data in Figure 2 are from the second phase of the study for the same subjects, representing the same response measures. Component lengths were of one minute duration as compared to five minute component durations in the first phase.

During Baseline, as in the first phase, response measures were approximately equivalent across the components compared. In the Experimental condition, during components where the sensory extinction procedure was implemented, the episodes of headstriking decreased from a mean of 60 in the last three baseline sessions to 46 in the first experimental session. Episodes increased to 56 over the next two sessions before decreasing to a mean number of

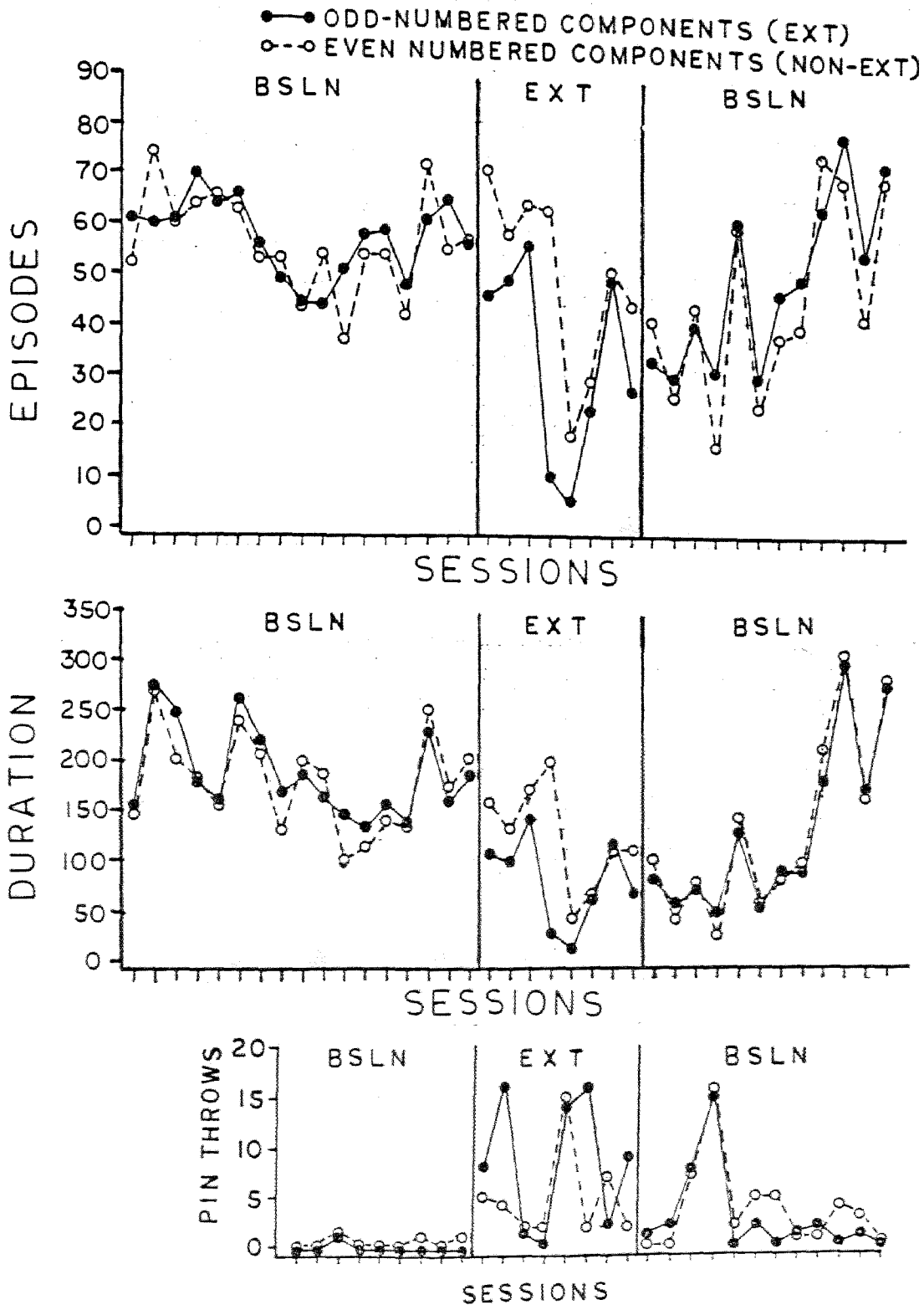

Figure 2 Episodes and cumulative duration of stereotyped headstriking (subject one) in extinction versus non-extinction components as a function of the sensory extinction procedure with component length of one minute. Collateral data of pin throwing also presented.

23 episodes for the remaining sessions. In components where the extinction procedure was withdrawn, the number of episodes increased from a mean of 61 in the last three baseline sessions to 71 in the first experimental session. The mean number of episodes in the next three sessions was 61, approximating baseline, before decreasing to a mean of 35 episodes for the remaining sessions. While the number of episodes increased across later experimental sessions, the numbers remained below baseline levels.

A similar pattern was observed for cumulative duration of time spent in responding. A decrease was eventually observed in components where the extinction procedure was implemented as well as in the components where it was withdrawn. In the Return to Baseline condition, the pattern of responding across all sessions for both measures was the same. Both measures returned to previous baseline levels, but did not do so until the ninth session. Until the return to previous baseline levels, response measures in the components compared approximated levels of responding during the last experimental sessions.

The number of pin throws were also recorded in this second phase. The data can be found in Figure 2. In the baseline condition, the number of pin throws were quite low, but there was a clear increase during the experimental condition. The results of the first phase were replicated with pin throws again observed in extinction components with the

foam pin, but pin throws were also observed with the plastic pin in components where the extinction procedure was withdrawn. The mean number of pin throws in the extinction components was approximately 8, in components with the procedure withdrawn, it was approximately 5. In the Return to Baseline condition, pin throws were equivalent across the components compared and the same pattern was observed. Pin throws in the two sets of components decreased in the first two sessions then increased to totals of 15 and 16 respectively over the next two sessions before decreasing to lower mean pin throws per session. This level of responding was slightly higher than previous baseline levels. It should also be noted that the increase in the number of pin throws in the return to baseline condition correlates with the reduced level of the response measures in the same condition. The measures did eventually return to baseline levels, but this followed in time the decrease in the number of pin throws.

Subject Two. Figure 3 shows the data from the first phase of the study where component lengths are of five minute duration. In baseline conditions, response measures were approximately equivalent across the components compared and show a great deal of variability. In the last ten baseline sessions, the mean number of episodes in components one and three, as well as two and four, was 13. Cumulative duration of head weaving decreased across

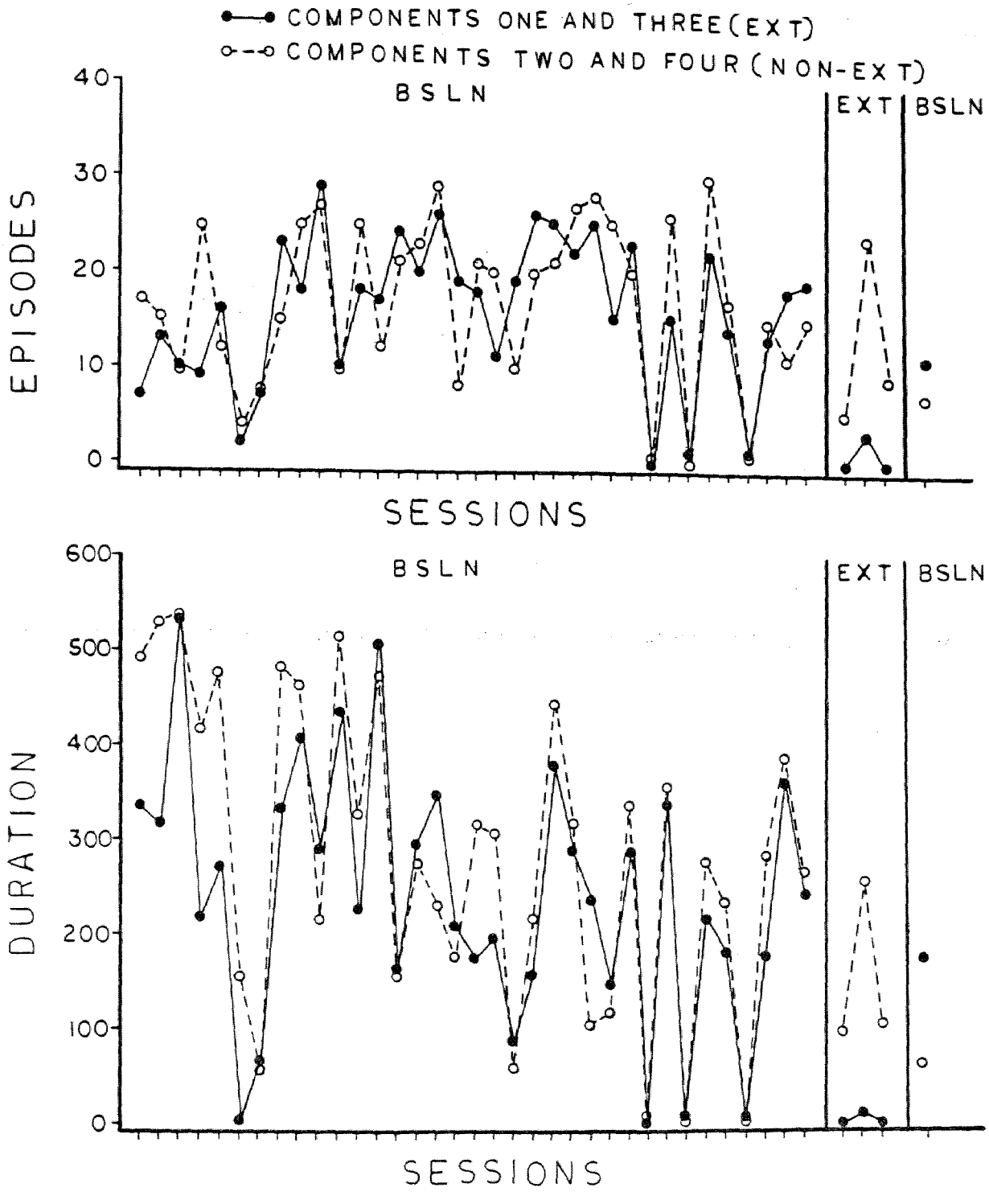

Figure 3 Episodes and cumulative duration of stereotyped headweaving (subject two) in extinction versus non-extinction components as a function of the sensory extinction procedure with component length of five minutes.

sessions. Mean duration in the last ten sessions was 179 seconds in components one and three, and 218 seconds in components two and four.

In the experimental condition, the mean number of episodes in sensory extinction components decreased to 1, cumulative duration decreased to a mean of 2.6 seconds. In non-extinction components, the response measures showed no change over baseline levels. Mean number of episodes was 12, mean cumulative duration was 150 seconds.

In the return to baseline condition, episodes of headweaving in the previous extinction components (one and three) increased to 11, the measure of cumulative time in responding also increased to 175 seconds. These levels approximate previous baseline levels. In the previous non-extinction components (two and four), episodes decreased to 7 and cumulative duration decreased to 60 seconds. Both measures were below previous baseline levels.

The data in Figure 4 are from the second phase of the study. Component lengths were of one minute duration as compared to five minute durations in the first phase. In the baseline condition, response measures in the odd-numbered components were approximately equivalent to the response measures in the even-numbered components. Mean number of episodes in the odd-numbered components was 12.5, the mean in the even-numbered components was 14. The mean cumulative duration was 519 seconds in odd components, and

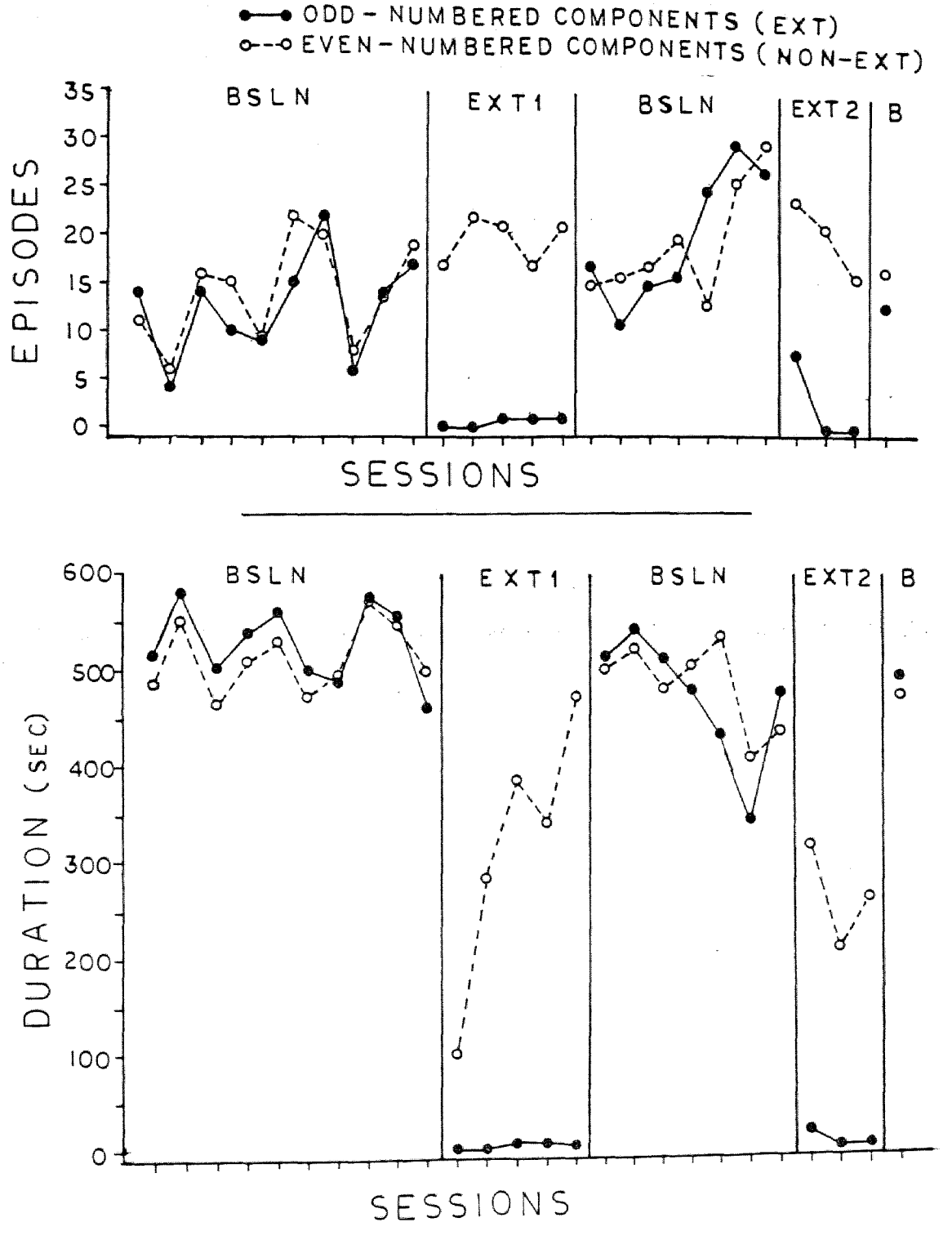

Figure 4 Episodes and cumulative duration of stereotyped headweaving (subject two) in extinction versus non-extinction components as a function of a sensory extinction procedure (Ext 1) and a modified sensory extinction procedure (Ext 2) with component length of one minute.

512 seconds in even components.

In the experimental condition, episodes and cumulative duration of headweaving decreased to almost 0 in the sensory extinction components (odd-numbered) across all 5 sessions. While episodes of headweaving decreased to a mean of less than 1 in the extinction components, episodes in the non-extinction components increased over baseline levels from a mean of 14 episodes to a mean of 21 episodes per session. The same results were not found with cumulative duration of headweaving. While episodes increased, the cumulative duration decreased to 103 seconds in the first session and showed an increase to 474 seconds in the final session. The mean cumulative duration was 319 seconds.

In the return to baseline condition, episodes and cumulative duration in the previous extinction components increased from their low experimental levels back to previous baseline levels. Episodes of headweaving, which showed an increase over baseline levels in the previous non-extinction components decreased back to previous baseline levels. Cumulative duration also returned to previous baseline levels.

In the second experimental condition, the mean number of episodes and cumulative duration decreased below baseline levels to 2.6 and 5 seconds respectively in extinction components. These results were similar to those

obtained in extinction components during the first experimental condition. In the non-extinction components, the number of episodes decreased across sessions whereas episodes increased during non-extinction components in the first experimental condition. The mean number of episodes was 20, which compares to the mean of 21 episodes found in the same non-extinction components in the previous experimental condition.

The relative increase in the number of episodes in the last three baseline sessions was well above all other baseline sessions, so an increase in episodes in the experimental conditions over baseline may not have been observed due to this increase. Cumulative duration again showed a decrease in non-extinction components.

In the return to baseline condition, the response measures in the previous extinction components again returned to baseline levels as did those measures in the previous non-extinction components.

CHAPTER IV

DISCUSSION

The purpose of this study was two-fold. First, the principle of sensory extinction (Rincover, 1978) was applied in an attempt to decrease behavioral stereotypies and to extend the findings concerning the usefulness of the concept of sensory extinction. Second, possible effects of the sensory extinction procedures on the target stereotypies in adjacent, non-programmed settings were also assessed.

The results do replicate previously reported findings (Rincover, 1978) demonstrating the effectiveness of sensory extinction procedures in decreasing behavioral stereotypies. In the present study, two different stereotypies were reliably decreased in number of episodes and cumulative session duration when the sensory consequences thought to maintain the responses were either masked or eliminated. When the specific consequences were again introduced, the number of episodes and cumulative session duration of responding returned to previous levels. These findings were replicated across subjects, across settings and across time.

Additional results of the study indicate that the sensory extinction procedures did have effects on the target responses in the adjacent settings. This systematically replicates research findings in the literature dealing with

schedule interactions (Pear & Wilkie, 1971; Reynolds, 1961; Spealman, 1978).

During the first phase for the first subject, the number of episodes in the non-programmed setting increased over baseline levels when the sensory extinction procedure was implemented in adjacent settings. While the increases in cumulative session duration of the same response were not as clearly shown, there were indications that some increase was present. Both measures then decreased back to previous baseline levels during the return to baseline condition. These results demonstrate the schedule interaction known as positive behavioral contrast (Reynolds, 1961).

While the response measures decreased well below baseline levels during extinction components for the second subject, the measures in the adjacent, non-extinction components did not appreciably deviate from baseline levels. The variability may have obscured any effect that may have been present.

In the study's second phase, the response measures of the first subject which demonstrated positive behavioral contrast indicated a different schedule interaction. While the response measures decreased during extinction components, the response measures in the non-extinction components also showed a decrease over sessions. Both measures of head-striking returned to baseline levels in the final condition. These results demonstrate the schedule interaction of

negative induction (Pear & Wilkie, 1971).

For the second subject, whose response measures of headweaving showed no appreciable difference across conditions in the first phase, the number of episodes and cumulative session duration of headweaving decreased during the sensory extinction components. During the non-extinction components, the cumulative session duration of headweaving showed the decrease below baseline levels also found in the previous subject's response measures. This gives evidence of negative induction occurring due to the interaction of the schedules. It is significant to note that while the cumulative session duration of the response decreased during non-extinction components, this decrease was not found in the number of episodes of headweaving. The number of episodes did increase slightly above baseline levels, although a clear contrast effect was not demonstrated. While both measures were related to the same behavioral stereotypy, the procedure had different effects on each measure.

Much, if not all, of the research to date on schedule interactions has been completed using laboratory animals as subjects. The general results of this study (that schedule interactions did occur) bears resemblance to those findings, yet there are noteworthy differences.

Positive behavioral contrast was demonstrated with one subject using procedures that are standard features of

investigations of schedule interactions. However, with another subject and a different behavioral stereotypy, no interaction was observed. Across both procedures, component duration was 5 minutes and there were 2 schedule alternations. In the second phase, the component duration was shortened to 1 minute. The literature would suggest that relative to the 5 minute component duration, the 1 minute duration would increase the interaction between the two schedules. The more rapid the alternations between the reinforcement and extinction schedules, the larger the contrast effect (Shimp & Wheatley, 1971; Todorov, 1972). In addition, the number of schedule alternations from extinction to reinforcement was increased to 10, due to the shorter components. With evidence that response rate changes are often most dramatic at the beginning of a component (Nevin & Shettleworth, 1966), a larger overall contrast effect could have occurred due to this increase in the schedule alternation.

Positive behavioral contrast was not demonstrated with the procedures modified to enhance such an effect. In fact, negative induction was observed in the response measures of both subjects, although for one subject, the number of episodes of headweaving did not demonstrate the induction effect. These findings appear contrary to those generally reported in the animal literature.

To date, the majority of studies concerned with

multiple-schedule interactions have dealt exclusively with positive contrast with pigeons as subjects. Species differences are evident in contrast experiments. When rats are subjects, the results are equivocal. A small number of these studies provide evidence for positive contrast, the results of most studies are often equivocal and sometimes clearly fail to find contrast (Freeman, 1971; Weiss, 1971; Dickinson, 1973). Negative induction was observed with squirrel monkeys under conditions similar to those that produce positive contrast with pigeons (Spealman, 1978).

The present results appear to fit into that category of studies which have produced equivocal results. Both positive contrast and negative induction were found with the procedures used. Additional research effort is needed to determine those variables giving rise to the schedule interactions observed.

A strict multiple schedule was not used in the present study. No external stimulus was programmed to signal which component was in effect, although the procedures used to implement the sensory extinction may have functioned in this capacity. An additional procedural difference of importance concerns the use of a schedule of sensory consequences as opposed to a schedule of food presentation produced by lever pressing or key pecking. The nature of schedule interactions may differ qualitatively with schedules of sensory consequences. Little work has been

done to date in this area.

Another finding from this study also parallels a phenomenon reported in the animal literature. This involves the first subject throwing the foam pin used in the sensory extinction procedure. During the baseline condition in the first phase, in which only the plastic pin was presented, no throws were recorded. Once in the experimental condition, pin throws were observed immediately and only occurred with the foam pin designed to eliminate the sensory consequence produced by the plastic pin. Rilling, Askew, Ahlskog, and Kramer (1969), set up a procedure in which a successive discrimination (reinforcement schedule alternating with extinction schedule) was programmed on one key. A response on a second key produced a timeout which terminated the reinforcement schedule or the extinction schedule. They found that the response occurred to this second key, producing escape from the extinction schedule. In the present study, no response was programmed to automatically remove the extinction schedule, but the response of throwing the foam pin functionally acted to remove the extinction schedule or more specifically, the stimulus associated with extinction (S-), the foam pin. Rilling asserted that the timeout response was an escape response and the rate of the response producing the timeout could serve as an indication of the aversive properties of the stimuli present when the response occurs.

That the foam pin may have taken on aversive properties is supported by Terrace (1966), who concluded that when a successive discrimination is established with responses to S-, the stimulus associated with the extinction schedule becomes a conditioned aversive stimulus due to frustration or emotional behavior produced by non-reinforced responding. The pin throws could be viewed as a direct measure of the aversive properties of the foam pin.

In the second phase of the study, pin throws again occurred with the foam pin during the extinction components. What was also found, was that pin throws occurred in the non-extinction component with the plastic pin. This continued into the return to baseline condition where the foam pin was not presented, only the plastic pin was present. While previous escape from S- studies indicate that there is some responding to terminate the schedule of reinforcement (Rilling et al., 1969; Terrace, 1966), these responses were minimal. It is also significant to note that this response was not observed in the previous phase. In considering the escape from S- response as an index of the aversive properties of the conditions present when the escape response occurs, it may be argued that the plastic pin also acquired aversive properties. Hence, the escape response of throwing the plastic pin.

An alternate explanation is that while the procedure may have generated a low rate of pin throws with the plastic

pin while it alternated with the foam pin, some other consequence following this response functioned to increase this rate. Following each pin throw, across both phases, the experimenter retrieved the pin and held it for a period of 10 seconds before presenting it back to the subject. This experimenter reaction could have served as a reinforcing consequence increasing and maintaining the rate of pin throws with the S+ or plastic pin. This response continued to occur at a high rate in the early session of the return to baseline condition, then pin throws decreased. Following this decrease, the response measures of headstriking returned to previous baseline levels.

These findings indicate that the stereotyped behaviors assessed in this study can be considered operant behavior under the control of its consequences, and that the principles of sensory reinforcement and sensory extinction play a functional role in the control of these behaviors. That extinction of stereotypies occurred when sensory consequences were eliminated or masked and schedule interactions were observed when the sensory consequences were under experimental manipulation leads to these conclusions.

The similarity to the phenomenon of escape from S- observed in the study also extends the findings of schedules of appetitive responding to the concept of sensory reinforcement and extinction.

While the results from this and other studies indicate the effectiveness of sensory extinction procedures, it may not always be easy to identify or effectively eliminate the sensory consequences maintaining a particular response. If a specific sensory procedure fails, it may be due to the fact that the behavioral stereotypy is not maintained by sensory consequences. The failure may also be due to the experimenter choosing an incorrect sensory consequence to manipulate although some other sensory consequence maintains the response. A third case involves the experimenter choosing the appropriate sensory consequence, but the procedure used to eliminate or mask the consequence was ineffective or the response was under multiple control by more than one consequence. There are additional difficulties if a specific extinction procedure is successful. It may be successful because the consequence identified was controlling the response and was effectively masked or eliminated. The success could be due to the fact that the procedure eliminated or masked all consequences related to that sensory modality, decreasing other behaviors as well as the stereotyped responding. A third case could be that the procedure served to reinforce incompatible responses that resulted in the decrease in the behavioral stereotypy.

In the present study, the vibrator could have provided stimuli which produced responses incompatible to headweaving. Anecdotally, the subject held his hands over

his ears from time to time while the vibrator was on and appeared to attend to the vibrator. This could have resulted in the decrease in the headweaving. The data also indicate that it was not necessarily the vibrating of the vibrator that controlled the headweaving. In the condition in which the vibrator was presented without being turned on, the same decrease in the number of episodes and cumulative duration was observed as when the vibrator was previously turned on, although this decrease could be due to the vibrator being paired with the vibrating stimuli in the prior experimental condition. Further controls could be implemented to assess what aspect of the consequence maintained control over responding. Such controls may take the form of using the sensory consequence to increase and maintain an arbitrary response when applied contingently to that response (Rincover et al., 1979).

It may also be argued that the use of the vibrator in this study, as well as in Rincover (1978), does not constitute a true extinction procedure. According to Rincover, the vibrator is used in order to mask the proprioceptive stimuli maintaining the stereotyped response, but there may be difficulties in going inside the organism to explain behavior. In this case, there is no measure to tell us if the proprioceptive stimuli are masked by the procedure. In addition, a stimulus not previously present in the environment was introduced in order to decrease the stereotypy.

This type of procedure more closely resembles positive punishment (Catania, 1979), and therefore, it may be misleading or inaccurate to talk about the operation as extinction. The use of the foam pin more closely resembled an extinction procedure. An environmental variable, the hardness of the plastic pin, was eliminated or masked by the use of foam rubber. Responding then decreased. While the effectiveness of this procedure gives support to the concept of sensory extinction, conceptual difficulties may arise when viewing the use of the vibrator as a sensory extinction procedure.

In the present study, continuous measures of the behavioral stereotypies were obtained. From these measures, two different dimensions of the responses were assessed: number of episodes and cumulative session duration. For one subject in the second phase of the study, while the dimension of cumulative duration decreased, the number of episodes showed a slight increase in the first experimental condition and were well over usual baseline rates in the second experimental condition. If only one response dimension was recorded and assessed, this additional information on the effects of the procedure could be missed. Little research has involved tracking multiple response dimensions (Kelly, 1977; Springer, Brown, & Duncan, in press) and data from the experimental literature does indicate that response dimensions can vary independently (Millenson & Hurwitz,

1961). More than one dimension can have clinical or experimental importance in an applied setting, but clinicians and researchers have little knowledge available to them on multiple dimensional changes.

While sensory extinction procedures appear to be useful in the control of behavioral stereotypies, little if any research has been carried out to assess any additional effects on responding due to these procedures. The present study has taken a step in the direction of providing such information.

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